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Quality assessment of home births in Denmark

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ABSTRACT

INTRODUCTION: The safety of home births has been widely debated. Observational studies examining maternal and neonatal outcomes of home births have become more frequent, and the quality of these studies has improved. The aim of the present study was to describe neonatal outcomes of home births compared with hospital births and to discuss which data are needed to evaluate the safety of home births.

METHODS: This was a register-based cohort study. Data on all births in Denmark (2003-2013) were collected from the Danish Medical Birth Registry (DMBR). The cohort included healthy women with uncomplicated pregnancies and no medical interventions during delivery. A total of 6,395 home births and 266,604 hospital births were eligible for analysis. Comparative analyses were performed separately in nulliparous and multiparous women. The outcome measures were neonatal mortality and morbidity.

RESULTS: Frequencies of admission to a neonatal intensive care unit and treatment with continuous positive airway pressure were significantly lower in infants born at home than in infants born at a hospital. A slightly, but significantly increased rate of early neonatal death was found among infants delivered by nulliparous at home.

CONCLUSIONS: This study indicates that home births in Denmark are characterized by a high level of safety owing to low rates of perinatal mortality and morbidity. Missing registration on intrapartum transfers and planned versus unplanned home births in the DMBR are, however, major limitations to the validity and utility of the reported results. Registration of these items of information is necessary to make reasonable assessments of home births in the future.

FUNDING: none.

TRIAL REGISTRATION: not relevant.

The safety of home births has been widely debated. Observational studies have become more frequent in Western countries and their methodological quality has improved [1]. Based on a literature review, the recent National Institute of Clinical Excellence guideline recommends to inform low-risk multiparous women that planning to give birth at home is suitable for them because of the lower rate of interventions and the same outcome for the neonate as for births in obstetric units [2].

Observational studies from the Netherlands and Canada found no differences in the risk of neonatal and perinatal mortality in home and hospital births, respectively [3, 4]. A Swedish cohort study showed a significantly increased risk of neonatal death in planned hospital births compared with planned home births [5], whereas an English cohort study reported a significantly elevated risk of perinatal mortality and intrapartum-related neonatal morbidities in nulliparous women giving birth at home compared with in a hospital [6].

Observational studies found no differences in the risk of a low Apgar score in infants planned to be born at home compared with infants born in hospital [5, 7-9]. An American cohort study reported an increased risk of a low Apgar score in planned home births compared with planned hospital births [10, 11], and The American College of Obstetricians and Gynecologists emphasizes the importance of careful evaluation of risk factors before recommending home birth [12]. However, the generalizability of these studies may be questioned as the qualifications of the birth attendants and the background of the women who chose home birth may differ from one population to the next. Cohort studies from New Zealand and the Netherlands showed no differences in the risk of admission to a neonatal intensive care unit (NICU) in infants born in planned home and hospital births, respectively [4, 7]. Additionally, a large descriptive study from the United States reported low prevalences of neonatal death, low birth weight and low Apgar score in planned home births [13]; and a review found no differences in neonatal morbidity (Apgar score and NICU admission), but suggested that more documentation of planned birth place would strengthen future studies [14]. In a Cochrane review published in 2012, one randomized controlled trial investigating outcomes in home and hospital births was identified, but the trial was too small to draw any conclusions [1].

Observational studies comparing outcomes in home and hospital births typically adjust for confounders to improve comparability between women giving birth at home and in hospitals. Most studies adjust for factors such as parity, education and body mass index (BMI), but it is often discussed whether motivational factors are different in the two groups of women. Psychological factors of pregnant women may likely influence the birth process, but it is complicated to adjust for such factors. This makes it harder to compare hospital and home

ORIGINAL ARTICLE

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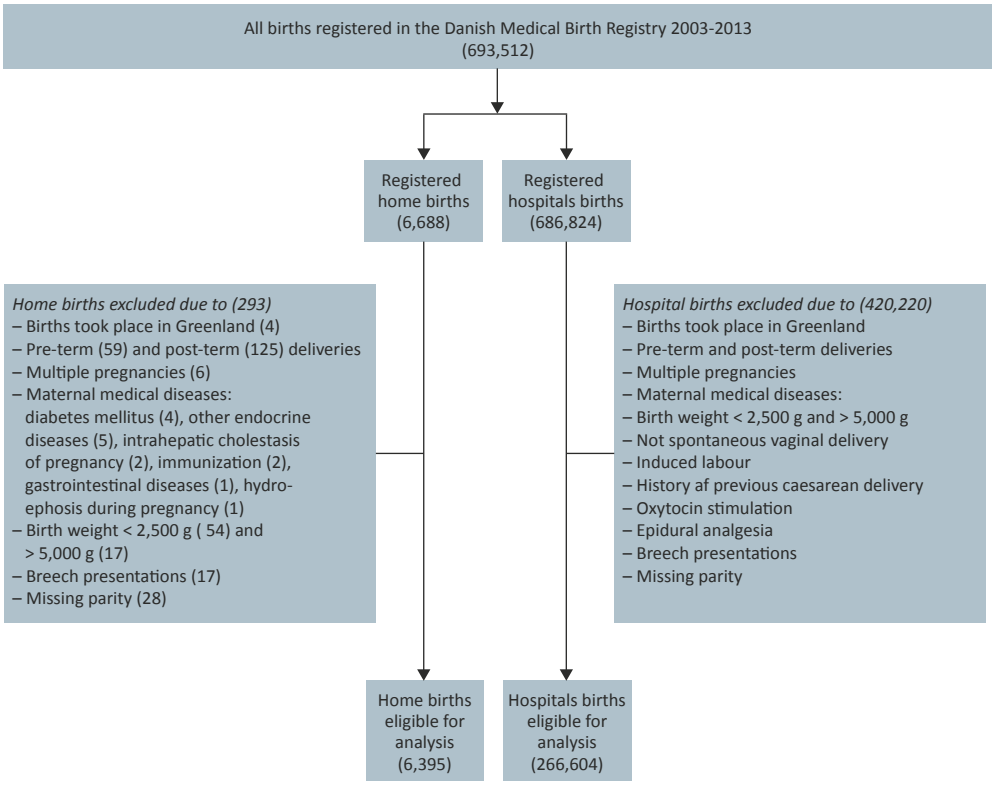
FIGURE 1

Flow chart of the selection of the participants (n).



birth and reduces the validity of the results of such comparisons.

About 1% of all births in Denmark are registered as home births [15]. All women in Denmark have the legal right to be attended by a midwife during a home birth – even in cases with any potential pregnancy or delivery complications [15]. Maternal and neonatal outcomes of Danish home births have not previously been examined. The aim of the present study was to examine neonatal outcomes of home births in Denmark between 2003 and 2013 compared with hospital births and to discuss which data are needed to evaluate the safety of home births.

METHODS

The Danish Medical Birth Registry (DMBR) was established in 1968, has been computerized since 1973 and covers 99.7% of all deliveries in Denmark. Since 1995, data in the DMBR have been obtained from the Danish National Patient Registry (NPR). Diagnoses regarding pre-pregnancy risk factors, medical diseases, complications and interventions during pregnancy, and delivery are recorded by codes according to the International Classification of Diseases and Related Health Problems, tenth rev., and the Nordic Medico-Statistical Committee classification of surgical procedures.

The present study includes all births recorded in the DNBR between 2003 and 2013; a total of 6,688 infants born at home and 686,824 infants born in hospitals. During the study period, data on home births were reported to the DMBR on printed forms completed by the midwife who attended the birth. Data on hospital births were reported electronically to the NPR. Home births are categorized as births where the infant is delivered outside hospital, planned or unplanned. Births by women who had planned a home birth, but who were transferred to hospital during labour were recorded as hospital births. As from 2013, home births attended by a hospital-employed midwife have been reported electronically through the NPR with specified codes for planned and unplanned place of birth.

Demographic characteristics included region of birth, maternal age and smoking status. The outcome variables included five-minute Apgar scores, admission to a NICU, continuous positive airway pressure (CPAP) and respirator treatment, neonatal sepsis, and neonatal death within 28 days. Infants with more than one admission to the NICU were only counted once.

Home births were included if they met the following criteria: Spontaneous onset of labour (gestational week 37 + 0 to 42 + 0), singleton pregnancy, no complications during pregnancy, no maternal diagnoses of any medical diseases except mental and behavioural disorders and diseases of the skin and subcutaneous tissue, birth weight between 2,500 and 5,000 g, cephalic presentation and parity not a missing variable. Hospital births were included if they met the above-mentioned inclusion criteria and the woman had a spontaneous vaginal delivery, no epidural analgesia or oxytocin augmentation and no history of previous caesarean delivery.

The selection of participants is described in **Figure 1**. Some home births were excluded due to more than one criterion why the exclusions do not sum to 293. Data were imported into SPSS statistics for analysis. All statistical tests were performed with two-sided p-values. $p < 0.05$ was considered statistically significant. The study was approved by the Danish Data Protection Agency (REG-19-2016). Reporting of the study followed the STROBE guidelines.

Trial registration: not relevant.

RESULTS

The final sample for this analysis consisted of 6,395 home births and 266,604 hospital births. During the study period, home birth accounted for approximately 1% of all births in Denmark annually. Region Zealand had the highest percentage of home births (**Table 1**). The frequency of women younger than 25 years was significantly lower for home births than for hospital births, and women giving birth at home were significantly more likely to be older than 35 years than women giving birth at a hospital. Nulliparous women giving birth at home were less likely to be smokers, but this trend was not found in multiparous women (Table 1).

Neonatal outcomes

No differences in low Apgar scores were observed. Admission to a NICU was significantly more frequent in infants born in hospitals than in infants born at home. Infants born in hospital were more often treated with CPAP, but this result was only significant in multiparous women (**Table 2**).

A significantly increased rate of death during the first seven days was found in infants from nulliparous giving birth at home than in infants of women giving birth at a hospital. Perinatal death in this sample was not correlated to maternal age as all deaths among home-deliveries occurred among women between 25 and 35 years.

In this study, hospitalization of infants born at home was examined. 23.8% and 23.3% infants from nulliparous and multiparous women giving birth at home were hospitalized for less than four days. Furthermore, 8.1% and 6.4% infants from nulliparous and multiparous women, respectively, were hospitalized for four days or longer.

DISCUSSION

According to data in the DMBR, women giving birth at home are more often multiparous, 25-35 years old and

TABLE 1

Home births and hospital births in regions of Denmark, 2003-2013, and characteristics of healthy nulliparous and multiparous women with uncomplicated pregnancies by actual place of birth. The values are n (%).

	Nulliparous			Multiparous		
	home births (N = 1,332)	hospital births (N = 89,005)	p-value	home births (N = 5,063)	hospital births (N = 177,599)	p-value
Region						
Capital Region of Denmark	372 (1.1)	32,330 (98.9)		1,384 (2.5)	54,820 (97.8)	
Region of Southern Denmark	368 (2.1)	17,359 (97.9)		856 (2.2)	38,997 (97.9)	
Central Denmark Region	241 (1.1)	21,021 (98.9)		1,006 (2.3)	42,264 (97.7)	
North Denmark Region	64 (0.8)	8,297 (99.2)		476 (2.6)	18,129 (97.4)	
Region Zealand	280 (2.7)	9,998 (97.3)		1,322 (5.3)	23,389 (94.7)	
Missing	7 (100)	0		19 (100)	0	
Maternal age, yrs						
< 25	153 (11.5)	17,519 (19.7)	< 0.001	161 (3.2)	8,490 (4.8)	< 0.001
25-35	1,027 (77.1)	64,053 (72.0)	Ref.	3,211 (63.4)	121,804 (68.6)	Ref.
≥ 35	152 (11.4)	7,433 (8.3)	0.007	1,691 (33.4)	47,305 (26.6)	< 0.001
Smoking status during pregnancy						
Non-smoker	1,156 (86.8)	75,126 (84.4)	Ref.	4,304 (85.0)	150,968 (85.0)	Ref.

TABLE 2

Neonatal outcomes by actual place of birth in healthy nulliparous and multiparous women with uncomplicated pregnancies, Denmark, 2003-2013. The values are n (%).

	Nulliparous			Multiparous		
	home births (N = 1,332)	hospital births (N = 89,005)	p-value	home births (N = 5,063)	hospital births (N = 177,599)	p-value
Apgar score						
5-min score < 7	4 (0.3)	313 (0.4)	1.0	6 (0.1)	405 (0.2)	0.13
Missing	60 (4.5)	262 (0.3)		291 (5.7)	734 (0.4)	
Admission to NICU						
< 4 days	9 (0.7)	1,641 (1.8)	0.001	20 (0.4)	2,112 (1.2)	< 0.001
≥ 4 days	13 (1.0)	1,226 (1.4)	0.24	14 (0.3)	1,092 (0.6)	0.001
CPAP treatment	11 (0.8)	1,114 (1.3)	0.21	8 (0.2)	1,068 (0.6)	< 0.001
Respirator treatment	1 (0.08)	43 (0.05)	0.48	1 (0.02)	58 (0.03)	1.00
Neonatal sepsis						
Streptococcus	2 (0.2)	49 (0.06)	0.17	1 (0.02)	69 (0.04)	1.00
Other	9 (0.7)	795 (0.9)	0.55	14 (0.3)	833 (0.5)	0.05
Neonatal death						
Stillbirth	0	25 (0.03)	1.0	0	42 (0.02)	0.63
Before 7 days	4 (0.3)	15 (0.02)	< 0.001	2 (0.04)	29 (0.02)	0.21
7-28 days	0	15 (0.02)	1.00	2 (0.04)	32 (0.02)	0.24

CPAP = continuous positive airway pressure; NICU = neonatal intensive care unit.

***Table 2 has been corrected per 30 April 2018.**

TABLE 3

Codes for classification of planned and actual place of birth defined in the Danish Healthcare Classification System (SKS), introduced in 2013.

SKS code	Description
DZ381B1	Live-born child born at home, planned
DZ381B2	Live-born child born at home, unplanned
DZ381Q	Live-born child born in a midwifery clinic
DZ 380Q	Live-born child transferred to hospital during planned home birth
DZ380R	Live-born child transferred to hospital during planned birth in a midwifery clinic

non-smokers. Home births are more frequent in Region Zealand, which may be because of the freestanding midwifery team in this region. The proportions of infants admitted to a NICU and treated with CPAP were significantly lower in infants born at home than in infants born in a hospital. We found a slightly, but significantly increased rate of early neonatal deaths among infants born at home by nulliparous women.

The strength of this study is that the sample is large and population-based. However, the study also has major limitations. First, categorization of home births into registration of planned or unplanned was not implemented until year 2013. In this sample, a third of all infants born at home were registered as hospitalized after birth. Presumably this proportion is unplanned home births as women giving unplanned birth at home are in some cases subsequently referred for a check-up at a hospital. Another limitation is that information on socioeconomic variables and other possible confounders such as the women's Body Mass Index was not available for this study and was therefore not adjusted for in our analyses. The third and most important limitation also relates to the methods of registration in the DMBR. Women with complicated home births who were transferred to hospital during labor were registered as having hospital births and information about the intrapartum transfers is not registered. This is a major limitation as women with complications during home births will be transferred to a hospital and the complications registered as having occurred during a hospital birth. Likewise, unplanned home births were included in the home birth group in this analysis and the results may therefore not be representative for women with a planned homebirth.

Due to missing registration of planned versus unplanned home births and intrapartum transfers in the DMBR, the results of this study are not sufficient to make a reasonable assessment of the safety of home births in Denmark. The method for reporting information on birth place to the DNBR was revised in 2013, making it possible in future studies to distinguish between births (planned and unplanned) at home and in midwifery clinics and to identify hospital births that were transferred from home or a birth clinic during labour (**Table 3**).

We excluded 54 and 17 home births, respectively, because of birth weights below 2,500 g and above 5,000 g. Furthermore, we excluded 17 home births because of breech presentations. Usually, women will be advised to deliver in hospital if pregnancy complications such as fe-

tal growth retardation, macrosomia or breech presentation are suspected during the antenatal visits. However, either these complications may be unrecognized in the routinely offered model of antenatal care, or the women could have chosen to give birth at home against medical advice as is their legal right. Failure to diagnose infants who are small for their gestational age or in breech presentation is an inherent risk associated with home delivery that should ideally be taken into account. However, we decided to exclude these groups as it would otherwise not be reasonable to make a comparison to hospital births. We are well aware that this may produce an inappropriate picture of the safety of home births depending on the reason for giving birth at home. Furthermore, we were unable to exclude home births among women with previous caesarean delivery. In a prospective cohort study from four Nordic countries (2008-2013), it was found that although women with a previous caesarean are in general advised to give birth in a hospital, 4.5% of the women with planned home births had a previous caesarean [16]. These limitations should be taken into account when interpreting the results of this study.

In this sample, poor validity of diagnosis registration seems to have an impact on the reported results. In Figure 1, four home births were excluded because of maternal diagnoses of diabetes mellitus. In Denmark, women diagnosed with diabetes mellitus are not recommended giving birth at home and the cases were considered registration errors or unplanned home births.

We found an increased proportion of admittances to the NICU and treatment with CPAP among infants delivered in hospital. This may either be explained by hospital births being more complicated or by the fact that it is easier to involve neonatal expertise when delivering in a hospital, which, in turn, leads to infants with minor problems more frequently being admitted to a NICU for observation.

For nulliparous women, we found a small association between home birth and neonatal death. Due to the limitations mentioned above, these results may not be valid for women with planned home births. However, the finding is in line with results from a large cohort study from England [6] were the risk of perinatal mortality and intrapartum-related serious morbidities was increased among nulliparous women with planned home birth (adjusted odds ratio 1.75, 95% CI 1.07-2.86).
A study from the Nordic countries showed that one third of nulliparous women with planned home delivery is transferred to hospital during labour [16], and further research should focus on risks and benefits of planned home birth for this group.

This study has a descriptive objective as it presents and evaluates neonatal outcomes in home births, but whether a comparison to hospital births is fair may be debated. A Swedish qualitative study using a descriptive design based on interviews of 12 women found that women planning home births have faith in their own competences and have a feeling of being in control, which seems to differ from women who plan for hospital births [17]. Furthermore, a Dutch cohort study described that women who plan for a home birth have different expectations about the birth and their own competences, and they are less receptive towards technology than women who plan for a hospital birth [18]. Observed differences in maternal and neonatal outcomes can possibly be explained by such differences in psychological factors in pregnant women, which are considerably more complicated to adjust for than non-psychological factors in observational studies [18]. Such factors should also be taken into account when interpreting the results of this study.

Home birth in water.

CONCLUSIONS

This study indicates that the safety of home births in Denmark is high owing to low rates of perinatal mortality and morbidity. We found a small, but significantly increased risk of early neonatal death among infants delivered at home by nulliparous women. However, missing registration on intrapartum transfers and planned versus unplanned home births in the DMBR limit the validity and utility of the results, and implementation of a registration that captures this information is needed to facilitate reasonable assessments of home birth in the future.

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CONFLICTS OF INTEREST: Disclosure forms provided by the authors are available with the full text of this article at www.danmedj.dk

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*CORRECTION PER 30 APRIL 2018

In a letter from Ole Olsen et al. (see comments) it was disclosed that there were mathematical errors in the incidences of complications among nulliparous women with hospital births presented in Table 2. Incidences and p-values have been recalculated and the errors in Table 2 have been corrected. We apologize for this. The corrections did not lead to any other changes in the manuscript (see comments).

COMMENTS

Letter to the editor

Ole Olsen, Senior Researcher, the Research Unit for General Practice in Copenhagen, University of Copenhagen
Jette Aaroe Clausen, Lecturer, Master in Health Humanities, Ph.D,
Susan Bewley, Professor of Women's Health, Kings College London, London UK

The paper "Quality assessment of home births in Denmark" (1) addresses an important topic, particularly as planned home births are rising. However, the authors and peer reviewers did not detect a number of critical errors:

Firstly, the title misleads as this is not a quality assessment. The paper describes the outcomes of actual home births over ten years, thus mixing planned and unplanned home births, and missing the planned-for-home but transferred-to-hospital births. Intention-to-treat analysis has long been considered imperative, otherwise the assessment of an intervention's effects are invalid. (2-4)

Secondly, there are mathematical errors in Table 2: we think that (a) 15/89,005 = 0.0169, not 0.008, and (b) 25/89,005 = 0.0281, not 0.01. Subsequently, the statistical significance given in the abstract seems to be based on erroneous calculations of neonatal death rates.

Thirdly, the interpretation of key results is wrong. The abstract states: "A slightly, [sic] but significantly increased rate of early neonatal death was found among infants delivered by nulliparous [sic] at home." The authors do not explicitly calculate a relative risk. As Table 2 shows, the relative risk would have been 0.3/0.008, i.e. 37.5, which is extremely high rather than "slight" (albeit unreliable, as above).

When we compare this present cohort to previously published and methodologically sound work (such as the mortality of planned home births in a large contemporaneous Dutch study) (5), the Danish neonatal death rate in the first week also seems extreme. It is 0.30% (unusually expressed in %), or 3/1000 (1) compared to 0.48‰ or 0.48/1000 in the Netherlands (5). The Dutch study demonstrates that it is possible to organize planned home births so that they are as safe as planned hospital births (5). If the Danish mortality really is many-fold higher, something crucial may be wrong with the organisation of home births in one or more health care regions.

The authors have access to the data and the expertise to interpret the medical notes. We urge them to provide a detailed case description of the four deaths each that occurred at home among nulliparae and multiparae.

We'd be grateful if the calculations were checked, errors were corrected, data re-analysed and the text and interpretation corrected accordingly (6). The author or editor may also choose to withdraw the paper (6).

Sincerely,
Ole Olsen
Jette Aaroe Clausen
Susan Bewley

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Reply to »Letter to the editor«

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MSc. Sabrina Jensen, Copenhagen
MD., PHD, Consultant, Lotte B Colmorn, Fertility Clinic, Rigshospitalet, University of Copenhagen
RM, MSc, Ph.D Anne-Mette Schroll, The Danish Association of Midwives

Thank you for giving us the opportunity to comment on this letter. We also thank for the interest in our paper "Quality assessment of home births in Denmark" (1).

Every day midwives and obstetricians spend a considerable amount of time on the reporting of data to the Danish Medical Birth Registry (DMBR). Since year 1973 the DMBR has collected data on all deliveries in Denmark. Data have been used for descriptive studies and quality assessment (2). However, descriptive studies of homebirths have never been published, and in the light the time spend on reporting of data to the DMBR we found it very important present national data. Thus, the aim was to disclose the available data and discuss which data we need for evaluation of the safety of homebirths and in this way encourage a midwives and obstetrician to report data by intended mode of delivery. Our approach was to show data and discuss all their limitations and this was our incentive to use the term "quality assessment" (of data) of homebirths in Denmark as a title.

Throughout the manuscript we have highlighted the importance of comparing data according to intended

and not actual birth place. The present quality of data, however, did only permit us to perform analyses by actual place of birth. Hopefully, this paper and current initiatives in collaboration between obstetricians and midwives will improve reporting of data om births outside hospital to DMBR.

We are embarrassed of the calculation errors in table 2. Fortunately, this did not affect the conclusion of the paper. We chose not to calculate risk estimates as quality of data on these extremely rare events were limited. We agree that presenting the p-values may deservedly be discussed

We are perfectly aware that the methodology of our study is different from the study by de Jonge et al. (3) as we did not have data on intended birthplace and no valid information on intrapartum transfers and unplanned homebirths . The overall mortality (intrapartum and within 28 days) in our low risk population was comparable to that in the Netherlands (0,6/1000 vs 1/1000 among nulliparous women and 0,6/1000 among parous women in both countries).

The present paper did not intend to estimate the mortality in planned homebirths, and the complications reported may be a result of unplanned or even unrecognized pregnancies or women with pregnancy complications who did not follow given advices.

We have concluded that validity of data on home births in the DMBR has major limitations and we foresee improvement in quality of data in the future.

Sincerely yours,
Lone Krebs,
Sabrina Jensen,
Lotte B. Colmorn,
Anne-Mette Schroll

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